

3D Printing for Model Trains



by Gert 'Jim' Muller aka Speed

What are you going to hear?

- Short **history** (but you can also read a Wiki)
- **Why?**
- **Printers** (the different kinds, the price, etc)
- **Materials** (plastic, plastic and more plastic, for now)
- What **work** is involved?
- Models (what do you send to a 3D printer, and where do you get that)
- Software (what? Software to make Hardware?)
- **Demo** (maybe we do that first)

3D PRINTING
GROFF
HANCOCK
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DGS
3D PRINTING SUPPLIES
3d.com.au



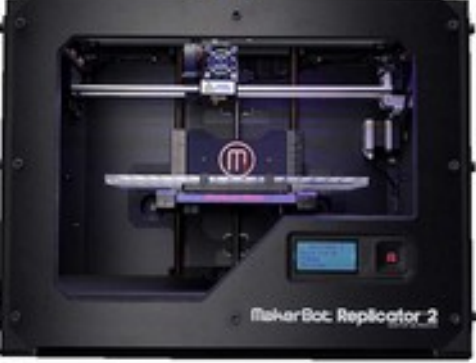
History...(in a nutshell)

- 3D printing or **additive manufacturing**, 1980
- **1984**: Chuck Hull, 3D Systems Corp, invented stereolithography, UV lasers to cure photopolymers (patent '86, now 25+ years later)
- **1990**: Plastic extrusion technology associated with "3D printing", commercialized by Stratasys as fused deposition modeling (FDM)
- **1995**, Z Corporation commercialized 3D printing (3DP), inkjet deposition of liquid binder on **powder**. Also known as drop-on-drop technologies.
- 3D printers and services: **\$2.2 billion** market worldwide in 2012
- **2005**: hobbyist and home-use market, open-source **RepRap** and **Fab@Home** projects.

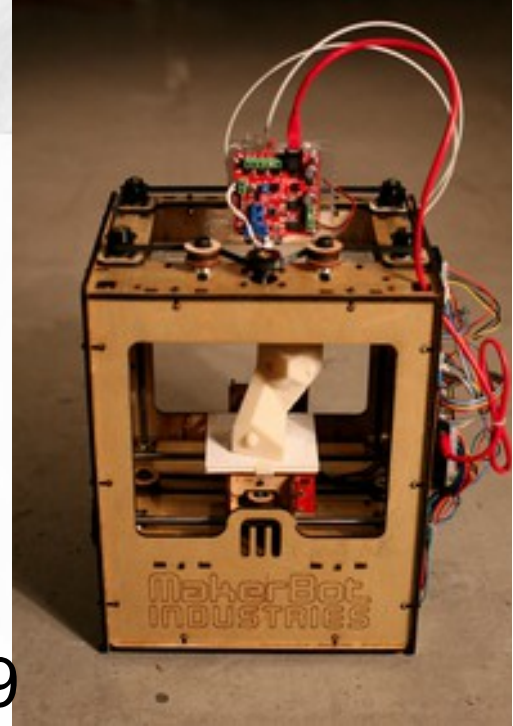
Why?

- **Price?**
- Unavailable? **Never made before** (HO vs N)?
- Needs something slightly **different**? Or extra?
- **You did it**, not from another nation!
- Some things are **harder** to make otherwise!

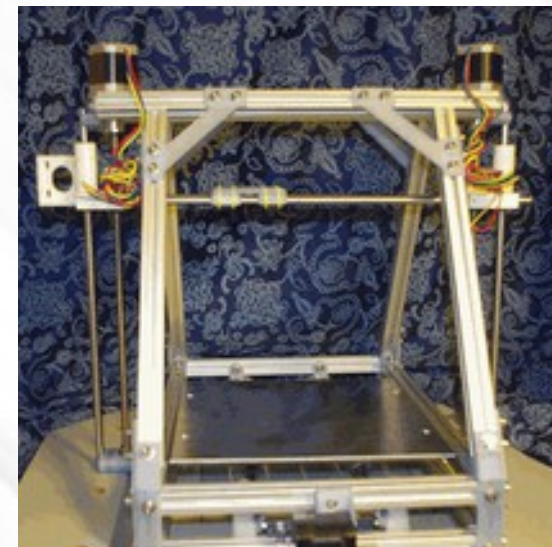




Printers (i)

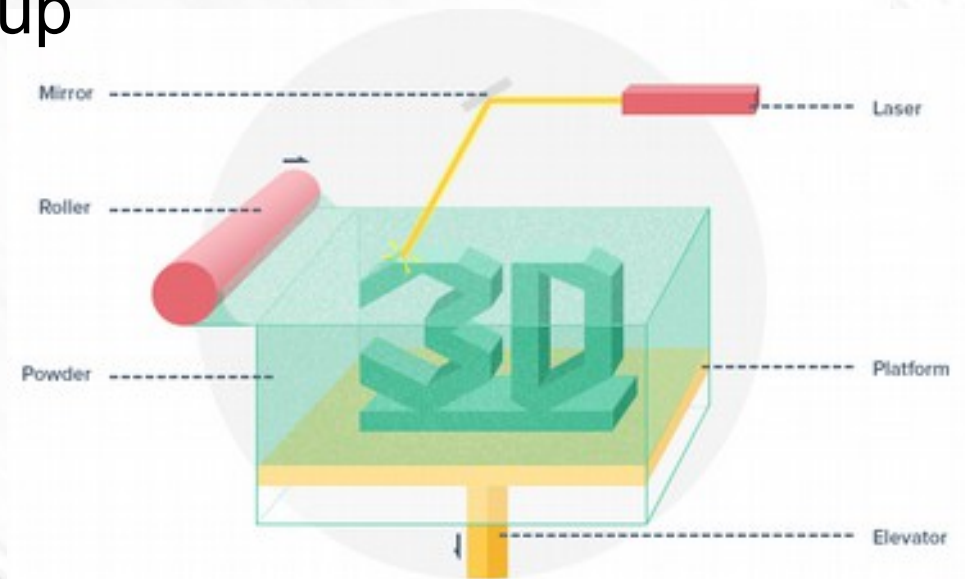


- FDM (Fused deposition modeling)
 - RepRap - \$149-\$1,499
 - MakerBot by Stratasys - \$349-\$2,999
 - 0.1mm (100 micron)
 - Lulzbot TAZ by Aleph Objects - \$2,195
 - DA VINCI 2.0 Duo, XYZ Printing (dual color) - \$734
 - Professional:
 - 3D Systems (\$10k+)



Printers (ii)

- **SLS (Selective laser sintering)**
 - **Powder** (laser or glue from above)
 - **No material support** needed printing part
 - Hard to buy these printers!
 - Not in the < \$3k group



Printers (iii)

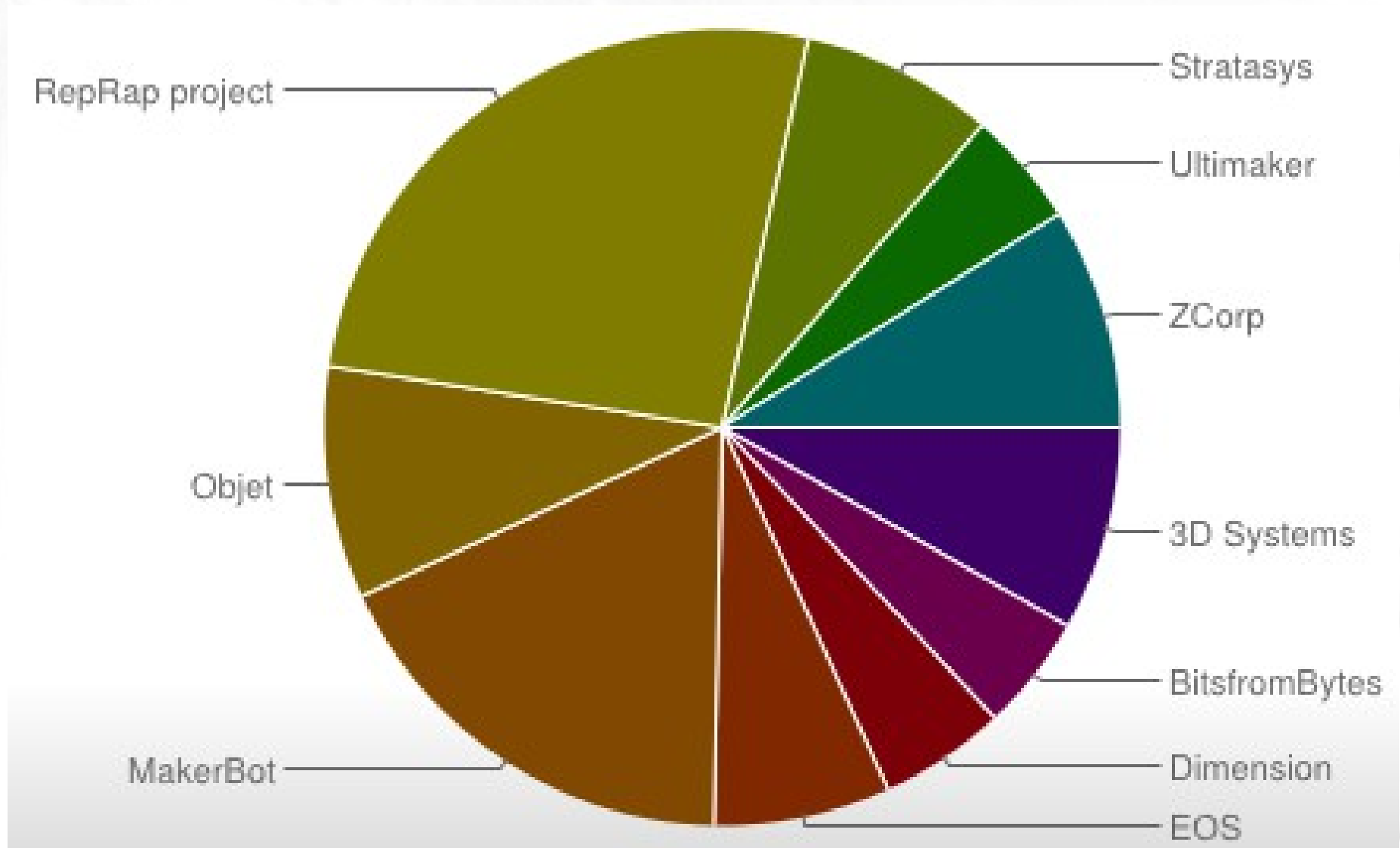


- SLA (**Stereolithography**)
 - **Liquid** (usually from below)
 - Form1+ by Formlabs - \$3,299
 - 0.025mm (25 micron, 300 micron xy)
 - Ilios HD by OS-RC
 - ProJet 1200 by 3D Systems - \$4,900
 - Pegasus Touch by FSL3D
 - Nobel 1.0 by XYZ Printing
 - B9 Creater by B9 Creations - \$3,375
 - (high resolution, 6.4 micron layer, 100 micron xy)
 - M-Ohe by Makex - \$1,699
 - 20 micron

Printers (iv)

- How do you **choose** one:
 - **Price** (hmmm, < \$3k)
 - Layer **thickness** (z-resolution, 100 microns or less)
 - XY **resolution** (300 microns)
 - Build **volume** (Form 1 has room for 5"x5"x6.5")
 - Speed (Minutes, Hours, Days)
 - Can you walk away
 - Tethered or not (Computer stays on too?)
 - Kit (**D.I.Y.**) or Built
 - Material cost
 - Size
 - Enclosed or Open

What did they choose?

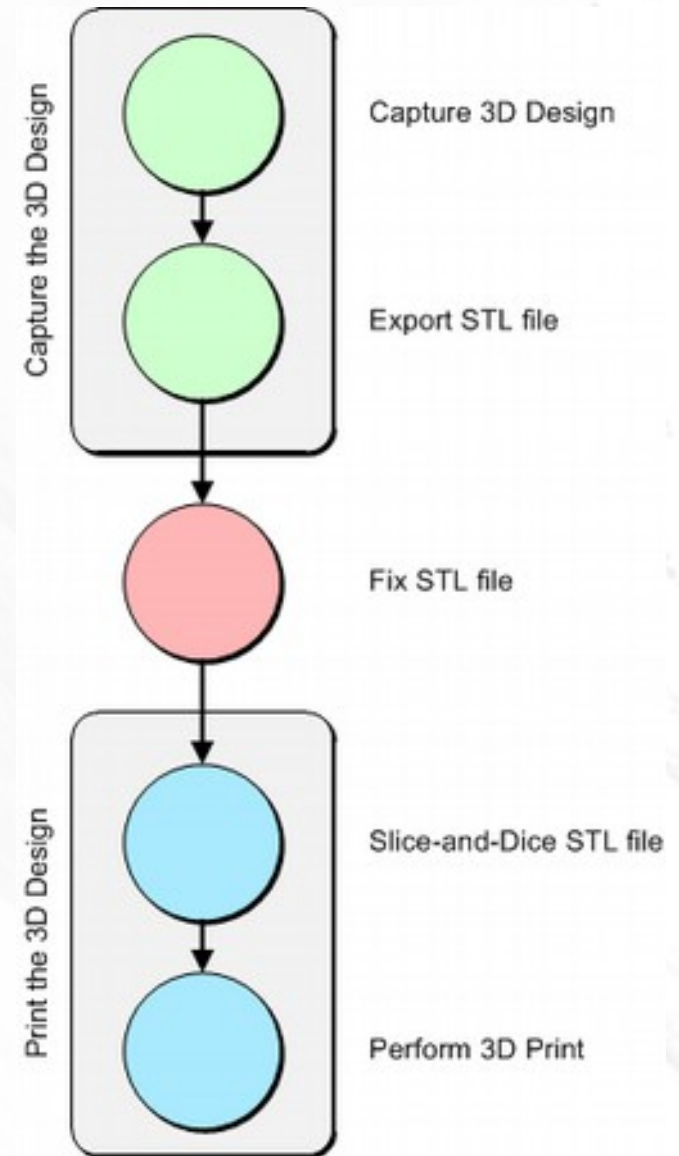


Materials

- Thermoplastics
- PLA (**Poly**lactic **Acid**) plant based, better smell, lower temperatures, faster printer (~180degC), **\$20/kg** at Microcenter
- ABS (**Acrylonitrile butadiene styrene**) oil based, strength, flexibility, machinability, and higher temperature resistance, smell (225degC), **\$20/kg** at Microcenter
- (hottest first) PC, Nylon, Abs, Bendlay, HIPS, PET, PLA, PVA, PCL
- LayBrick (chack), LayWoo-D3 (40% wood), Taulman 618/645 EcoFlex PLA
- **Glow in the dark**, Conductive, Composite, Metal Flake
- **Candy or Sugar**
- Form1 uses **UV cured resin**, twice as hard as ABS when cured, \$149/liter

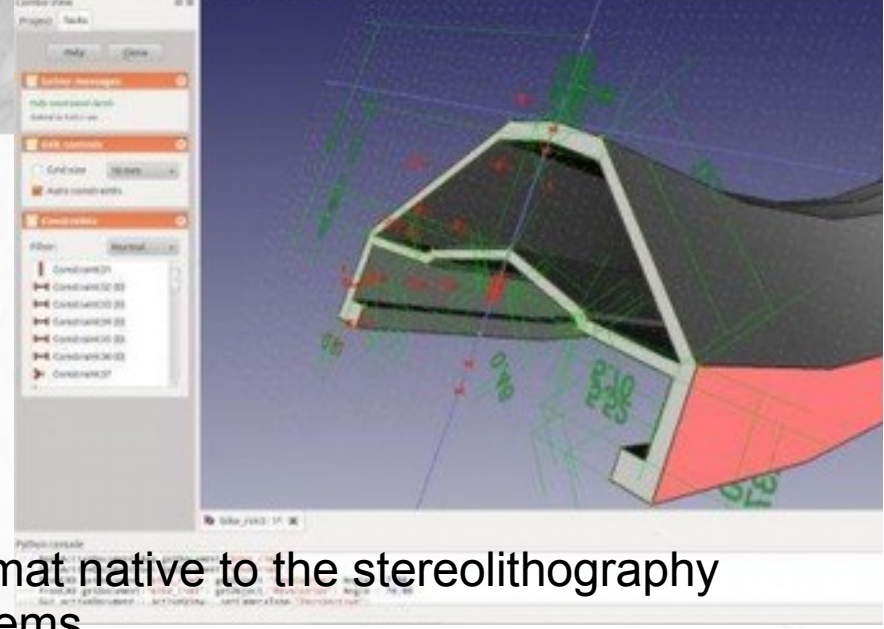
How?

- Capture, Buy or Draw the 3D design (Solid Model)
- Generate the .stl file
- Fix the file (triangles need to line up)
- “Slice and Dice”, i.e. make layers
- And press Print (or Form, or 3D)



Models (i)

- You need a .stl file
 - STL (STereoLithography) is a file format native to the stereolithography CAD software created by 3D Systems
- **Design/Draw** your own solid model
 - \$: SolidWorks, Pro-E, AutoCAD 3D, Inventor, CREO, *GeoMagic Design*, Cheetah3D (mac)
 - \$0: Sketchup, Blender, Wings 3D, FreeCAD, 123D Design, HeeksCAD, Art of Illusion, Tinkercad (web) and OpenSCAD (scripting)
- **Or scan it** with a 3D Scanner, see E4D.com in Richardson, Tx



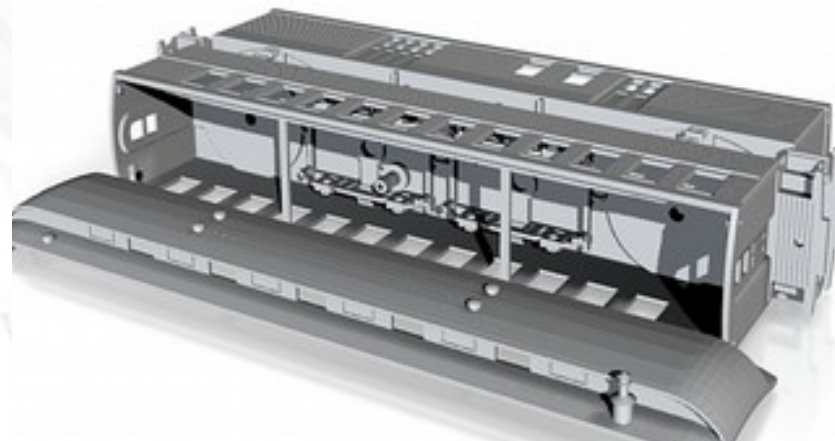
Models (ii)

- **Or buy it** (the .stl file)

- Shapeways:

<http://www.shapeways.com/model/884931/nn3-chili-line-train>

- Thingiverse:
100,000+ models



[YouMachine \(Ultimaker\)](#)
[Treasure Island \(Pirate3D,\)](#)
[123D's Gallery \(Autodesk\)](#)

[Shapeways](#)
[Sculpteo](#)
[MakerBot's Digital Store](#)

[CGtrader](#)
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[Cults](#)
[3D Model Free](#)

Demo

- FormLabs: Form 1
 - Liquid solidified by UV laser in 100um, 25um or 10um layers, 300 micron XY resolution
 - Free layering software (PreForm)
 - Import .stl (auto-fix)
 - Auto-place
 - Auto-support generation
 - “Form” (the cool form of “print”)

References...

- http://en.wikipedia.org/wiki/3D_printing
- <http://makergeeks.com/>
- <http://www.gizmag.com/mcor-iris-paper-3d-printer/32903>
- <http://www.microcenter.com/category/4294898923/3d-printers-and-accessories>
- <http://www.edn.com/electronics-blogs/systems-interface/4421382/10-3D-printers-under--1000>
- <http://www.3ders.org/pricecompare/3dprinters/>

Or

- Handheld 3D Pen for \$99

